CLAIMS

1. Displacement machine comprising:

- two profiled members (1, 2; 12, 11), inner and outer respectively, that have an annular inner profile and an annular outer profile respectively (3, 4; 14, 13),
- a connecting member (25) connected rotatably to each of the profiled members (1, 2; 12, 11) along a respective axis of rotation (O, O'; O', O),

and in which:

- one of the profiles (3; 13) is m-lobed and the other (4; 14) is (m-1)-lobed, and they are defined around the axis of rotation of their respective profiled member by m and (m-1) respectively, pattern(s) comprising a lobe dome arc and a lobe hollow arc,
- each profile is the envelope of the other during relative rotations of the profiled members around their respective axis of rotation with meshing of their profiles, which define the chamber contours between them, and rolling without sliding between two pitch circles centred on the respective axes of rotation,

characterised in that the relative positions of the profiled members (1, 2; 12, 11) for which a point of contact (C_2) between the profiles is located on the tangent (T) to the two pitch circles (6, 7) at their mutual rolling point (R), the profiled members (1, 2; 12, 11) have at said point of contact equal continuous curvatures in the same direction with said rolling point (R) as their common centre.

2. Machine according to claim 1, characterised in that:

- the points M on a given arc that is one of the two arcs of the m-lobed profile being defined by two functions $\rho(\delta)$ and $\sigma(\delta)$ connecting parameters ρ, δ and σ, which are:

ρ: measured along the normal to the arc at point M, the distance between point M and the middle N between the two

points of intersection P and D, proximal and distal respectively, of the said normal with the pitch circle with centre O of the m-lobed profile, and with a radius assumed equal to 1, the proximal point of intersection P being located between point M on the given arc and the distal point of intersection D,

δ: angular half-distance between D and P relative to the centre O, measured clockwise,

σ: polar angle of the proximal point of intersection P relative to O, minus δ,

the functions $\rho(\delta)$ and $\sigma(\delta)$ having a domain of between $\delta=0$ and $\delta=\pi$,

- two arcs of the pattern of the (m−1)-lobed profile are a proximal conjugate arc and a distal conjugate arc defined below in a Cartesian reference system with their origin at the centre O of the pitch circle associated with the m-lobed profile:

a) proximal conjugate arc:

$$x_{CjP}(\delta) = (1 + (\sin(\delta) - m\rho(\delta))\sin\left(\frac{\delta - m\sigma(\delta)}{m-1}\right) + (m-1)\cos(\delta)\cos\left(\frac{\delta - m\sigma(\delta)}{m-1}\right))/m$$

$$y_{CjP}(\delta) = ((\sin(\delta) - m\rho(\delta))\cos\left(\frac{\delta - m\sigma(\delta)}{m-1}\right) - (m-1)\cos(\delta)\sin\left(\frac{\delta - m\sigma(\delta)}{m-1}\right))/m$$

b) distal conjugate arc:

$$x_{CjD}(\delta) = (1 + (\sin(\delta) + m\rho(\delta))\sin\left(\frac{\delta + m\sigma(\delta)}{m-1}\right) + (m-1)\cos(\delta)\cos\left(\frac{\delta + m\sigma(\delta)}{m-1}\right))/m$$

$$y_{CjD}(\delta) = (-(\sin(\delta) + m\rho(\delta))\cos\left(\frac{\delta + m\sigma(\delta)}{m-1}\right) + (m-1)\cos(\delta)\sin\left(\frac{\delta + m\sigma(\delta)}{m-1}\right))/m$$

3. Machine according to claim 2, characterised in that the derivative ρ' relative to δ where $\delta = 0$ and $\delta = \pi$ satisfies the following strict inequalities:

$1/m > \rho'(0) > 0$

$-1/m < \rho'(\pi) < 0$

in that the m-lobed profile is inside the (m-1)-lobed profile, and

in that the m-lobed profile is complemented by a proximal complementary arc defined by its coordinates in the said Cartesian reference system:

$$x_{CpP}(\delta) = ((2\sin(\delta) - m\rho(\delta))\sin\left(\frac{2\delta}{m} - \sigma(\delta)\right) + m\cos(\delta)\cos\left(\frac{2\delta}{m} - \sigma(\delta)\right))/m$$

$$y_{CpP}(\delta) = ((2\sin(\delta) - m\rho(\delta))\cos\left(\frac{2\delta}{m} - \sigma(\delta)\right) - m\cos(\delta)\sin\left(\frac{2\delta}{m} - \sigma(\delta)\right))/m$$

4. Machine according to claim 3, characterised by the fulfilment of the following conditions over the entire interval $]0,\pi[$ of variation of the coordinate δ:

$(\rho(\delta)\rho'(\delta))/\cos(\delta)-\sin(\delta)\neq 0$

$(m\rho(\delta)-2\sin(\delta))\rho'(\delta)/(m\cos(\delta)) - (2m\rho(\delta)+(m^2-4)\sin(\delta))/m^2 \neq 0$

$(m\rho(\delta)-\sin(\delta))\rho'(\delta)/((m-1)\cos(\delta)) - (\rho(\delta)+(m-2)\sin(\delta))/(m-1) \neq 0$

$(m\rho(\delta)+\sin(\delta))\rho'(\delta)/((m-1)\cos(\delta)) + (\rho(\delta)-(m-2)\sin(\delta))/(m-1) \neq 0$

5. Machine according to claim 3 or 4, characterised in that the functions $\rho(\delta)$ and $\sigma(\delta)$ are:

$\rho(\delta) = (1-1/n)(1/\cos(\varphi)^2)-\cos(\delta)^2)^{1/2}+(1/n)\sin(\delta)+\rho_0$

$\sigma(\delta) = (1-1/n)\arccos(\cos(\delta)\cos(\varphi))+(\delta/n)$

that define the given arc as a curve parallel to a shortened epicycloid, and where:

n is a real number that is the order of the epicycloid,

φ is an angular parameter of between 0 and $\pi/2$, which describes the shortening,

ρ_0 is a parameter characterising the distance to the base epicycloid.

6. Machine according to claim 5, characterised in that n is taken as close to 2m-2.

7. Machine according to any one of claims 3 to 6, characterised in that it comprises:

- two flanges (28, 29) between which the profiled members (1, 2) are installed, and which are rotatably connected to one of the profiled members;

- inlet ports (16) through a first (28) of the flanges near a side of each of the lobe domes of the profile of the profiled member to which the flanges (28, 29) are rotatably connected;

- discharge ports (17) through a second of the flanges near another side of each of the said lobe domes.

8. Machine according to claim 7, characterised in that it comprises means (21, 22) of selectively closing at least some of the ports in at least an angular area close to an intersection between a common tangent (T) of the pitch circles (6, 7) and on the other hand curves of action (CA_1, CA_2, CA_3) defined by the trajectories of the points of contact between profiles.

9. Machine according to claim 7, characterised in that there is an angular displacement between a profile of the profiled members (1,2) on the side of one of the flanges and a profile of the profiled members on the side of the other flange, such that each chamber (V_5 - FIG. 15) passing through its maximum volume ceases to communicate with a port (16) through one of the flanges approximately at the moment when it starts to communicate with a port (17) through the other flange.

10. Machine according to any one of claims 3 to 9, characterised in that it comprises in the profiled outer member, distribution channels (18, 19) opening on the one hand into the profile (4) at the connection of the arcs and communicating on one side of the lobe domes with the intake and on the other side of the lobe domes with the discharge.

11. Machine according to claim 2, characterised in that the derivative ρ' relative to δ where $\delta = 0$ and $\delta = \pi$ satisfies the following strict inequalities:

$-1/m < \rho'(0) < 0$

$1/m > \rho'(\pi) > 0$

in that the m-lobed profile is outside the (m-1)-lobed profile; and

in that the m-lobed pattern is complemented by a distal complementary arc defined by its coordinates in the said Cartesian reference system with centre O:

$$x_{CpD}(\delta) = ((2\sin(\delta) + m\rho(\delta))\sin\left(\frac{2\delta}{m} + \sigma(\delta)\right) + m\cos(\delta)\cos\left(\frac{2\delta}{m} + \sigma(\delta)\right))/m$$

$$y_{CpD}(\delta) = (-(2\sin(\delta) + m\rho(\delta))\cos\left(\frac{2\delta}{m} + \sigma(\delta)\right) + m\cos(\delta)\sin\left(\frac{2\delta}{m} + \sigma(\delta)\right))/m$$

12. Machine according to claim 11, characterised by the fulfilment of the following conditions over the entire interval $]0,\pi[$ of variation of the coordinate δ:

$$(\rho(\delta)\rho'(\delta))/\cos(\delta)-\sin(\delta)\neq 0$$

$$(m\rho(\delta)+2\sin(\delta))\rho'(\delta)/(m\cos(\delta)) + (2m\rho(\delta)-(m^2-4)\sin(\delta))/m^2 \neq 0$$

$$(m\rho(\delta)-\sin(\delta))\rho'(\delta)/((m-1)\cos(\delta)) - (\rho(\delta)+(m-2)\sin(\delta))/(m-1) \neq 0$$

$$(m\rho(\delta)+\sin(\delta))\rho'(\delta)/((m-1)\cos(\delta)) + (\rho(\delta)-(m-2)\sin(\delta))/(m-1) \neq 0$$

13. Machine according to claim 11 or 12, characterised in that the profiles only pass through a single point of tangency with the outermost trajectory (CB_3) followed by the contact points.

14. Machine according to any one of claims 11 to 13, characterised in that the functions $\rho(\delta)$ and $\sigma(\delta)$ are:

$$\rho(\delta) = (1+1/n)(1/\cos(\varphi)^2 - \cos(\delta)^2)^{1/2} - (1/n)\sin(\delta) - \rho_0$$

$$\sigma(\delta) = (1+1/n)\arccos(\cos(\delta)\cos(\varphi)) - (\delta/n)$$

that define the given arc as a curve parallel to a shortened epicycloid and where:

n is a real number that is the order of the epicycloid,

φ is an angular parameter of between 0 and $\pi/2$, which describes the shortening,

ρ_0 is a parameter characterising the distance to the base epicycloid.

15. Machine according to any one of claims 1 to 14, characterised in that each lobe is symmetrical relative to an axial plane passing through the vertex of the lobe.

16. Machine according to any one of claim 1 to 15, characterised in that each lobe is dissymmetrical relative to an axial plane passing through the vertex of the lobe.

17. Machine according to any one of claims 1 to 16, characterised in that the connecting member is firmly attached to a housing (25), and in that one of the profiled members is at least indirectly rotatably connected to a drive shaft (23).

18. Machine according to claim 17, characterised in that the other profiled member rotates freely around its axis of rotation.

19. Machine according to any one of claims 1 to 18, characterised in that the profiles are each progressive along the axis of rotation of their respective profiled member, the points of tangency of the pitch circles being aligned on a straight line parallel to the two axes of rotation.

20. Machine according to claim 19, characterised in that the profiles are progressive by angular displacement of a constant profile around the axis of rotation.

21. Machine according to claim 20, characterised in that the profiles progress into a constant pitch helix.

22. Machine according to any one of claims 1 to 18 or 31, characterised in that the profiles are constant along their respective axis of rotation, have a constant degree of angular displacement, finite or infinite, along their respective axis of rotation, in that the profiled members can be moved axially relative to each other, and in that the machine comprises at each end a flange (51, 52) complementary to one of the profiles respectively and resting tightly against an end surface of the profiled member holding the other profile.

23. Machine according to any one of claims 19 to 21, characterised in that the angular displacement of the profiles from one end surface of the profiled members to the other is hardly greater than the lifetime angle of each chamber relative to the respective profiled member.

24. Machine according to any one of claims 1 to 23, characterised in that the profiled members are mounted between two flanges (28, 29) closing the chambers at their axial ends, and in that the machine comprises pressing means to press the flanges axially against the profiled members.

25. Machine according to claim 24, characterised in that each flange (28, 29) is rotatably firmly attached to one of the profiled members.

26. Machine according to claim 24 or 25, characterised in that the pressing means are means of subjecting at least part of the outer surface of a first of the flanges to the high pressure of the working fluid to push the first flange against the profiled members and thus push the profiled members against the second flange.

27. Machine according to claim 26, characterised in that the machine comprises means of distribution that comprise at least one port (16, 17) formed in the first flange (28, 29) for the high-pressure working fluid.

28. Machine according to claim 27, characterised in that the means of distribution comprise at least one port formed in the second flange for the low-pressure fluid.

29. Machine according to claim 27 or 28, characterised in that the ports (28, 29) are rotatably connected to the profiled outer member (2).

30. Machine according to any one of claims 1 to 26, characterised in that it comprises means of distribution that comprise ports rotatably connected to one of the profiled members, preferably the (m-1)-lobed profiled member (2), and that are selectively revealed and hidden by the other profiled member (1).

31. Machine according to claim 5 or 30, characterised in that the ports have tips coinciding with the connection point of the arcs forming the profile to which the ports (16, 17) are integral, on the appearance side of the chambers for the inlet ports and on the disappearance side of the chambers for the discharge ports.

32. Machine according to any one of claims 1 to 30, characterised in that one of the profiled members (61, 81) has two m-lobed profiles, one on a radially inner annular surface and the other on a radially outer annular surface, which have the same pitch circle and each cooperate with an (m-1)-lobed profile, and in that the

(m-1)-lobed profiles have the same pitch circle and are held by the other profiled member.

33. Machine according to claim 32, characterised in that the two m-lobed profiles (83, 93) are facing away from each other and are radially between the two (m-1)-lobed profiles (84, 94).

34. Machine according to claim 32, characterised in that the two m-lobed profiles (63, 73) are facing towards each other and are radially on either side of the two (m-1)-lobed profiles (64, 74).